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ABSTRACT

Originally prepared for the Workshop to Increase and to Improve University Teacher Training Programs in Adult Basic Education, Chicago, March 1969, this paper reviews a five year project, begun in 1966, on adult age differences in cognitive performance and learning. One purpose of this project is to determine differences in cognitive abilities, with special reference to items selected as suitable for adults of differing ages; to survey the educational background and skills that younger and older adults bring to learning situations; and to study age differences in learning orientation and other relevant personality characteristics. Another aim is to investigate experimentally the interaction of the above variables with a learner's age in determining learning and performance. Eighteen references are included. (LY)

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COGNITIVE CHANGES IN ADULTHOOD[1]

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A paper prepared for the Workshop to Increase and to Improve University Teacher Training Programs in Adult Basic Education

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The purpose of this presentation is to review a relatively long-term research project presently in progress at Syracuse University. A brief history of the project's beginnings will be followed by a discussion of its purposes and its present status. The presentation will conclude with a brief discussion of the future plans for the project.

History

The project is a five-year program of research funded by the U. S. Office of Education[3], and is formally titled "A program of research in adult age differences in cognitive performance and learning: Backgrounds for adult education and vocational retraining." (For easy identification, this project is styled as the "Syracuse University Adult Development Study.") The project was started in mid-1966 by the late Raymond G. Kuhlen and by Eric F. Gardner, and is presently directed by Dr. Gardner and the author.

The first two years of the program were devoted in large measure to an extensive review of literature,[4] designing and building equipment, developing data collection instruments, designing -- and conducting pilot work for -- experimental studies, and developing a pool of adult subjects.

In short, the first two years were largely devoted to "tooling up." This phase has, for the most part, been completed, and the major part of the program is now underway.

It would be inappropriate to conclude the history of this program without mention of the contribution made by Raymond G. Kuhlen who was, with Dr. Gardner, the co-founder. Dr. Kuhlen was a noted developmental psychologist, whose major interests were the psychology of adolescent development and the psychology of maturity and old age. In the field of gerontology, he is probably best remembered for his contributions to the study of age trends in motivation and adjustment. During the last year or two of his life, his attention was focused in particular on motivation and on personality variables that might differentially influence learning during young adulthood, middle age and in the later years of life. Dr. Kuhlen's contribution to this project was profound, and his loss deeply felt. His contribution continues, not only through the groundwork he laid, but as well through his influence on the author, who was his student.

It would be equally inappropriate to fail to acknowledge the initial and continuing contribution of Dr. Gardner, who is, to all intents and purposes, the co-author of this paper. He is a distinguished expert in measurement and statistics and educational psychology, perhaps best known to many of you as a senior co-author of the Stanford Achievement Test and other tests in the "Stanford complex", and most recently of the Adult Basic Learning Examination (ABLE).

Purposes of the "Adult Development Study"

This project grew out of the recognition of the social importance of programs aimed at the retraining and vocational rehabilitation of workers at all levels and of all ages. It was given impetus by concern over the lack of scientific information about the role of personal variables in complex human learning at different adult ages. There can be little doubt that the degree to which the productive abilities of adults of different ages can be utilized in various types of work situations, and the degree to which adults can be effectively and efficiently retrained, depends in large measure upon our understanding of their intellectual resources and learning ability.

This is not meant to imply that a good deal is not already known. Indeed, another panelist in this workshop, Dr. Jack Botwinick, has recently published an excellent critical and interpretive review of research on adult cognitive processes[5] and is, himself a distinguished contributor to this area. Thus, a very substantial body of research data on adult learning has been accumulated since the early reports of E. L. Thorndike thirty to forty years ago.[6] But most research has served primarily to describe age differences in learning and performance as evidenced in laboratory types of tasks.[7] Little research has been done on the more <u>meaningful</u> types of verbal learning, nor has much been directed toward an analysis of the types of variables, particularly <u>personal</u> variables, that might differentially influence learning at different times in adult life. While there have been many studies of age differences in performance on "intelligence" tests, such data are relatively restricted in scope especially with respect to the sampling of abilities with items appropriate to older adult groups. Little is known regarding the range of educational knowledge and skills (reading comprehension, arithmetic skills general knowledge) that people of different ages bring to learning tasks. Nor is much known regarding adult age differences in motivation to achieve or in degree to which adults experience apprehension and anxiety in situations requiring new learning.

One purpose of the program of research is to determine age differences in cognitive abilities with special reference to items selected as suitable for adults of different ages, to survey the educational backgrounds and skills that older and younger adults bring to learning situations and to study age differences in personality characteristics of a type likely to influence the individual's learning. A second main purpose of the research is to investigate <u>experimentally</u> the interaction of the variables mentioned above with age of the learner in determining learning and performance. The general plans for these two aspects of the program of research are described in the following sections of this paper.

The first of the two aspects of this research program involves a determination of adult age differences in a variety of abilities and personal characteristics of presumed importance in learning at different adult ages. The following description relates to studies of adult age differences in (a) cognitive abilities, (b) educational background, and (c) learning orientation.

Adult Age Differences in Cognitive Functioning

It is obvious that the ability of adults of different ages to profit from educational and/or training or retraining programs will depend in part on the types and levels of abilities they bring to those tasks. Yet, except possibly for Wechsler's studies with an intelligence scale designed for use with adults[8] and a minor study by Demming and Pressey,[9] there has been no systematic nor extensive effort to explore adult age differences in cognitive abilities as such abilities are revealed on a wide range of types of individual items or on items appropriate for adults of different ages. Mainly, explorations of intellectual differences during the adult life span have been accomplished by means of tests that have been developed for an standardized on young adult populations, such as college students or army selectees. And these studies have focused upon age differences in sub-test and/or total test scores, with little attention paid to age trends in individual items. The resulting data have serious limitations for an understanding of adult abilities. It is not improbable, in the first place, that tests designed for young adults will prove to be biased against older adults, and thus that the observed decrements in test performance noted with increasing adult age may simply reflect the structure of the test. In the second place the sub-tests employed (e.g. vocabulary, general information) are relatively short and homogeneous.

In the light of these circumstances, it is likely that some of the seemingly well-established generalizations regarding mental functioning (e.g., those relating to the stability of the functions measured by vocabulary and information) reflect an over-simplification of the problem. In contrast to stability over age, it is reasonable to expect that rather important age trends would be found to occur if a wider variety of items were sampled and varying levels of scoring criteria employed. One would anticipate, for example, that vocabulary relevant to various interest patterns would show gains or losses as interest in those areas waxed and waned. It would further be anticipated that in a technologically dynamic culture, in contrast to a static culture, new concepts (new words) and new information would be generated at a relatively rapid rate and transmitted with greatest force to the young people (to late adolescents and young adults) in a society. Under these circumstances, older people presumably would be at a disadvantage compared to younger people in their knowledge of new concepts though they may equal them or even have an advantage on information items relating to the more static elements of the culture.

These considerations lead to the expectation that much is to be learned about adult intellectual functioning through the construction of a wide variety of different types of items, and especially through the development of items that are differentially appropriate for the various age bands of the adult population. One major phase of this research program involves the development of such items and the exploration of adult abilities by these means.

We have thus far developed on the order of twenty tests specifically aimed at discerning differential age trends among adults. About a dozen of these are cast essentially in the form of specialized vocabulary tests. Knowledge of terminology in such areas as modes of transportation current at various times in the past 75 years; financial matters, including stocks and bonds estate management, wills, and installment buying; diseases and other medical matters peculiar to various adult ages and matters related to life termination; fashions in clothing in this century; arts and literature, and hobbies and sports popular among different age groups. Two particularly interesting developments have been vocabulary tests of slang current among different generations and of words coined and/or deemed acceptable by lexicographers at different times in recent history. These tests are of particular interest because of the degree of objectivity that it has been possible to achieve in constructing them, i.e., through the sampling of contents of slang and unabridged dictionaries. As you may discern, the major effort has been to develop tests that contain items designed to give one generation a particular advantage over another, either by virtue of members of the generation having lived in the culture at the time when now-obsolete or extinct modes of transportation, entertainment, language, etc., were current, or by virtue of the existence of age-related experiences, e.g., disease, or interests, e.g. wills and estate management vs. installment buying. Six vocabulary tests have reached an advanced stage of development and are currently being administered to a large number of individuals. Others are coming along, and some are being rewritten as the result of findings from preliminary administrations.

Eight or ten additional sets of items in various formats are also being developed, all having undergone at least one preliminary administration. Some of these are designed to sample interest and/or experience domains such as cooking and/or recipe manipulation, card playing understanding time tables and road maps, etc. Others are designed to determine age differences in test-taking behavior, e.g., guessing strategies, distraction by irrelevant information, response ommission, ability to follow directions, etc.

While a major aspect of the analysis of the data consists of the establishment of age trends and sex differences for individual items and significant groups of items, attention is also being directed to the possibility that ability as so assessed may have differential validity at different ages. Exploration of this issue

is being accomplished in two ways (a) through the determination of age differences in the correlation of the individual items with total score on arrays of items, and (b) through the correlation of performance on such arrays of items with some learning criterion, such as performance on the laboratory tasks to be described later in the present paper.

Adult Age Differences in Educational Background

The ease with which adults of different ages can effectively deal with demands made upon them in training or retraining programs will also depend to no small degree upon the amount of relevant knowledge and learning skills such as reading, that they bring to such tasks. Since older adults tend to have less formal schooling than younger adults, and are more remote in time from that schooling, it is reasonable to expect that they would bring less in the way of background to the learning tasks they face. However, it is possible that social and occupational demands made upon at least some adults will result in informal learning to such a degree as to more than compensate for expected deficiencies. Thus the actual level of background knowledge and educational skills, that adults possess can be ascertained only by direct check. Thus, one phase of the research program consists of a survey of the educational level of adults of various ages. An appropriate instrument for such a survey is under development, the ABLE test earlier referred to. It contains subcales relating to such knowledge and skill areas as arithmetic skills -- both computation and problem solving reading comprehension, general vocabulary, and spelling. While there has been a degree of overlap between certain of the items included in this instrument and items involved in the tests outlined above, the distinction between the two is the degree to which such skills and knowledge are explicitly taught in schools. The types of items included in the survey using ABLE consist of formally taught school materials.

While there have been some scattered studies of adult age differences in educational background, no study has systematically and extensively explored this matter. Most conclusions regarding such matters are based on indirect inferences from the administration of standard intelligence tests.

Adult Age Differences in Learning Orientation

The extent to which adults of different ages are positively oriented toward the seeking of new educational experiences (whether these be in a voluntarily selected course in continuing education or in re-training programs necessitated by change or work) or the degree to which they react negatively to such learning opportunities because of uncertainty or apprehension may, in a practical sense, be of even greater importance than the abilities or the backgrounds they bring to such tasks. They may, in fact, avoid such situations.

But even when involved in a learning program, the level of an individual's performance will likely be determined to no small degree by the extent to which he is "achievement oriented" or threatened by the situation in which he finds himself.

It has been rather clearly established, for example that in complex types of learning, anxiety tends to have a negative effect reducing performance. This may come about because, among other reasons, the anxious or threatened person experiences some confusion between "competing" responses, is unable to attend to the task, or tends to make up his mind too quickly as to how he should proceed. In view of the theoretical, as well as the practical importance of such personal variables in the learning of adults of different ages, a third element has been included in the survey of adult age differences, namely what has here been called "learning orientation". We are interested in determining whether middle age and old age brings positive or negative changes in these respects.

The relevance of different types of learning orientation variables to adult learning can be commented upon more economically in connection with the procedures being utilized (or planned) for measuring these various characteristics.

It is necessary in this phase of the study to obtain information regarding four types of characteristics (a) motivation for learning and achievement, (b) learning apprehension or anxiety, (c) personal rigidity, and (d) "style of life" or learning sets. Each of these will be discussed briefly in turn.

What has here been labeled "motivation for learning" refers to what is commonly called achievement motivation -- the desire to achieve and accomplish either in competition with one's own self, with an absolute standard of competence or with others. In a sense, we are concerned here with the likelihood that adults of different ages will seriously apply themselves to learning tasks. The measure being employed in this study is being patterned after existing scales designed to measure achievement motivation, e.g., Edwards Personal Preference Schedule and Sarason's Autobiographical Survey.[10]

The measures of "learning apprehension" relate to the degree of apprehension, uneasiness, or nervousness generated by learning situations or various cognitive task situations that an individual faces. Several types of measures are being tried, e.g., one relating to what has been called "test anxiety", another commonly reffered to as "manifest" anxiety. The first type of scale (test anxiety) is being developed in the pattern of existing scales though phrased with due regard to the adult age of the sample here studied and the types of situations adults face. The scale of manifest anxiety is also being adapted from existing scales. The primary requirement in these instances is that the scales be brief, though reliable, that subscales sample anxiety generated in different situations, and that the overall scale be acceptable to adults of varying ages. One

important assumption in theories attributing causal significance to anxiety in producing age-related variance in performance and in other aspects of personality is that anxiety becomes more general and less situational with increasing age. This asumption is being tested in the present research.

A measure of "rigidity" (conceptualized here as a "need" for structure) is included among the scales being employed and planned in this phase of the study because of the theoretical importance of rigidity in learning. Evidence seems to suggest that people do, indeed, become more rigid with increasing adult age (though the data are not entirely consistent), but it is desirable to determine whether rigidity as measured by the type of instrument employed here does in fact increase with age, since this same measure will be employed in the experimental portion of the research program as described later. Evidence exists indicating that the rigid person prefers certain types of learning tasks (school subject matter, for example) and learns more effectively with relatively structured teaching procedures. However, the rigid person may also pose for himself certain handicaps to learning by reaching premature decisions (premature closure) regarding solutions to problems or by incorporating into his perception of the problem or its solution elements that are in fact irrelevant. A short form of the dogmatism scale utilized by Rokeach[11] in research on rigidity as related to learning problem solving, and other behaviors, has recently become available and is being used both in its own right and for further developments.

A final measure of personal characteristics planned for use relates to what might be called "<u>style of life</u>". It is probable that the individual who has devoted his time to recreations of a non-intellectual sort will be less competent in learning tasks than an individual who has a history of active participation in activities involving initiative, responsibility, and new learning. What is here called "style of life" refers essentially to what Harlow[12] has referred to as learning sets. It is not unlikely that a part of the threat that seems to be posed for older adults by new learning situations stems from the fact that they are aware that they have not participated in new learning for some years, and thus do not have the appropriate orientations ("sets") for such learning. Quite aside from the extent to which threat is involved lack of experience in learning may prove a serious handicap to the older learner. Accordingly, it seems desirable to attempt to measure this characteristic, and to determine the degree to which adults of different ages are so characterized.

Two instruments, consisting primarily of surveys of the types of activities in which people have recently engaged -- the activities being carefully selected with reference to the degree to which they involve initiative and new learning -- have recently been developed, one by Dr. Roy Ingham[13] of Florida State University and one by Dr. Ann Litchfield[14] of the University of Chicago. We look forward to using one or both of these.[15] In a sense what is being

measured here is not only the character of present experience but the degree of positive affect associated with living in general but especially as related to new learning experiences. This instrument will be further developed to measure "learning set" more specifically.

The second major aspect of the program of research outlined in this document relates to the actual performance of individuals of different ages in learning tasks, and the interaction of various personal characteristics with age in the performance of those tasks. Several major hypotheses give direction to this series of studies. They are stated here in a general way.

Major Hypotheses

The first major hypothesis being investigated is that a measurable portion of the decrement in learning performance usually found with increased adult age may be attributed to the greater susceptibility of older adults to psychological stress. The ways in which anxiety may influence learning has been suggested above. Available evidence (see summaries by Kuhlen[16]) indicates that older adults tend to exhibit more anxiety symptoms than do young adults especially under stressful conditions, thus suggesting one possible explanation for learning decrements with increasing adult age.

We are currently running a fairly extensive experiment to assess the effects of "social stress" on adults ranging in age from the early twenties through the seventies. Subjects are drawn from the memberships of several co-operating social, cultural, and social, and religious organizations in the Syracuse area. The treasury of each organization is enriched in proportion to the number of its members and adults in their families as volunteer to participate. Subjects, segregated by sex, are randomly assigned in order of appearance to one of two conditions. The control group consists of three subjects seated side-by-side in the same room, but visually inaccessible to each other, working each at his own pace through eighteen multiple-choice items presented one-by-one on individual projection screens. There are six verbal reasoning items, six perceptual reasoning items, and six arithmetic problems presented in mixed order. Each item is presented automatically for a maximum of 60-65 seconds, which is, for the vast majority of people, more than ample time. Thus, little or no stress is engendered by time pressure. Subjects indicate their choice of the alternative answers by pushbutton, and are given immediate knowledge of results on each item by signal lights. The experimental group performs the same task, but subjects can see and converse with each other, and can see one another's signal lights, so they know whether the multiple-choice selected by one of them was right or wrong. As in the control group, each subject proceeds at his own pace. It is difficult for subjects to read the item presented on other than their own screen, so there is little chance for contamination. Furthermore, the middle subject is, in reality,

a stooge -- one of two members of our staff, of the same sex as the subjects. The stooge is instructed to work faster than the two subjects, i.e., to stay two to three items ahead of the faster of the two subjects. The stooge's console is rigged to indicate on the signal lights that 16 of the 18 responses he (or she) makes are correct, regardless of the choice buttons pushed. The stooge also makes "helpful remarks" along the way, such as "Gee these are easy," or "Hey, there's a trick to solving these." These remarks are carefully scripted and standardized so that all subjects get the benefit of the same performance. At no time, incidentally does the stooge direct comment individually at either subject, so there's "nothing personal" in his or her remarks.

The basic idea, of course, is to provide the subjects in the experimental group with a social stress situation that is not too far different from the type of experience that might be encountered in an adult education class when people disparate in ability, experience, and age are gathered together.

The dependent variables are number of correct responses, latency of response, degree of confidence in response -- which is also indicated by the subject with pushbuttons, and deviation in heartrate from pre-experimental baseline, which we assume to be a measure of stress experienced. Subjects also complete pretest and posttest anxiety questionnaires.

The experiment is still in progress, so there are no results to be reported. We have peeked at a part of the data, however, and it is our impression that male subjects aged in the fifties and forties are making more correct responses than males in the twenties and thirties but that the older male subjects in the stress condition are more affected relative to their controls than are the younger men. It must be emphasized that this is only a preliminary impression; however, if it holds up through the end of the experiment it should prove to be very interesting. That is, we fully expect the stress condition to be more deletirous to the older subjects, but we have no reason to expect that the level of performance will be generally higher among the older people.

The second general hypothesis relates to the role of personality variables such as attitudes. It has been shown in previous research that individuals who hold unfavorable attitudes have more difficulty in both learning and rememoering verbal material related to those attitudes. This is a somewhat controversial area of research with recent studies suggesting an interaction between emotional and cognitive variables in determining the poorer performance of those with attitudes unfavorable to the content of material to be learned. In view of the greater rigidity and dogmatism of the older adult, it may be predicted that the emotional element has greater weight for him than for the younger individual in this interaction than does the cognitive element. In other words it is hypothesized that the degree to which an older adult can learn controversial

material is influenced by his attitudes to a greater degree than is true for the younger adult. We have not as yet gotten beyond a very preliminary pilot study with regard to this hypothesis.

The third type of hypothesis involves the relation of "learning sets" to age losses in performance in learning situations. The learning set hypothesis asserts that, for one reason or another older adults do not know how to learn as well as younger people. In his classic paper Harlow[17] defined learning set as "learning how to learn a kind of problem, or transfer from problem to problem" Thus, learning set refers to a nonspecific transfer of learning -- the transfer of knowledge of the tools and techniques of learning rather than the transfer of a specific subject matter. In the context of aging, it is proposed that as adults grow older they encounter fewer occasions requiring new learning and therefore the habits of learning they developed during formal schooling and in the early years of maturity have deteriorated through lack of practice. To illustrate this concept in the classroom setting the individual who has been out of the routine of formal schooling for any appreciable length of time is likely to have lost a substantial portion of whatever he may have known about how to learn. I am thinking here of such "tools of learning" as knowing how to study how to concentrate or focus attention, how to organize the work, how to take notes, and a myriad of other "mental adjustments" and attitudes towards the process of learning.

Those of you who have taught courses enrolling people who have been out of the school routine for some time have no doubt had the experience of dealing with students who, after the first class meeting, gather at the lectern to express serious doubts about their ability to compete in an academic setting. Some of them, to be sure are merely having problems in rearranging the priorities of their daily lives to find time for studying, but there are those genuinely concerned about recapturing their skill in the mechanics of learning.

While the statement above of the learning set hypothesis was couched in terms of chronological age, it should be noted that age per se is not the critical independent variable. The critical variable is, of course, the cognitive style of life of the individual. That is, individuals who are more or less continuously engaged in making use of the tools and techniques of learning should suffer little or no deterioration in learning set. Thus older adults who have maintained learning sets may be expected to perform more nearly like young adults than will those who have not maintained learning sets.

Some evidence bearing on this point comes from the study conducted by Levinson and Reese.[18] Levinson and Reese compared the performance of children, college students, institutionalized and community-dwelling aged, and retired college faculty on a classic Harlow-type object-quality discrimination learning set series. Performance increased with age in the early years reaching a peak in the college-age group, and decreased with age thereafter. Of

particular interest, however, was the finding that the retired faculty were markedly superior to the other aged subjects. These investigators suggested that "an initial high IQ and/or considerable educational achievement may be more significant variables than CA... Presumably the learning ability of older Ss and their capacity to deal effectively with large amounts of incoming information is maintained by large amounts of educational experience".

The first of the planned series of studies in our research program was a learning set investigation.[19] The major purposes of this study were to examine suggestions that there are, in addition to the deficit due to loss of response speed with age, deficits in concentrating or focusing upon the materials to be learned. The paired-associate paradigm was used. The anticipation interval was held constant, and the inspection interval varied, to test the hypothesis that the performance of older subjects would suffer more than that of younger subjects when the time allowed to review the stimulus-response pair was limited. Furthermore, it was felt that if the predicted deficit was due to difficulty in concentrating or focusing upon the materials at a fast pace, then if subjects were given the opportunity to accustom themselves to the experimental situation--in other words, to form a learning set--the age difference should be reduced. To this end, each subject learned successively six unrelated lists of paired associates

The subjects were 40 women, 20 in their thirties and 20 in their sixties, all recruited from women's religious organizations through the technique of offering to pay the organization four dollars for each person delivered from the membership.

Older and younger subjects did not differ at the 5% level either in mean score on a 20-item vocabulary test, nor in mean number of years of schooling. The average subject had finished high school and had some post-high school training such as business school, nurses' training, or some college. The younger women were all housewives and mothers active in parochial school activities, while the older were, for the most part, either currently employed or recently retired from clerical office jobs or work of that general category. In summary, both the older and the younger subjects were active, involved, community-dwelling individuals of a reasonably high educational level.

Subjects were randomly assigned to one of two conditions of presentation of six 12-pair lists. In the slow pace condition, subjects learned the lists to a criterion of one perfect recitation, or a maximum of nine trials, at a 4:2-second rate. that is four seconds anticipation time and two seconds inspection time. In the fast pace condition, subjects learned to the same criteria at a 4:1-second rate. The presentation device was a Stowe memory drum. The pairs of words were all two-syllable adjectives, and the six lists had been approximately equated for difficulty in a pilot study. Nevertheless, two of the six lists appeared equally often in the

first and sixth positions of presentation to provide complete counter-balancing of residual inequalities in list difficulty at the endpoints of the learning sequence. The other four lists were assigned randomly to the second through fifth positions of presentation in such a way that each subject within each age by pace condition learned the six lists in a different order. Thus, the relationship between the groups and the relationship of the first to the sixth list learned were not confounded with residual inequality in list difficulties.

See Table I and Figure I

Fig. I shows the mean number of total, omission, and commission errors, and Table I gives the results of the repeated measures analyses of variance. Individual comparisons for the total errors measure showed that the older group at the slower pace and the younger group at the faster pace improved significantly from the first to the sixth list learned, while the other two groups did not change significantly from the beginning to the end of the series.

Table I. Summary of analyses of variance of error measures over six lists

Source of Varation	df	Total Errors Mean Square	F	Omission Errors Mean Square	F	Commission Errors Mean Square	F
Between Ss							
Age (A)	1	273.1	<1	199.8	<1	5.7	<1
Pace (P)	1	5078.4	4.6	3667.5	4.6[1]	175.1	2.1
A x P	1	4437.6	4.1	2059.2	2.8	451.0	5.3[1]
Error(Between)	36	1091.6		733.2		84.5	
Within Ss							
Lists(L)	5	237.1	3.7[2]	170.1	3.4[2]	20.2	1.8
A x L	5	123.2	1.9	55.8	1.1	21.4	1.9
P x L	5	50.7	<1	38.0	<1	8.6	<1
A x P x L	5	154.7	2.4[1]	72.2	1.4	17.6	1.6
Error(within)	180	64.0		50.7		11.2	

Note - All figures calculated to two decimals, rounded to one Means and variances for total and omission errors were correlated; however, there was no change in locus of significance after square root transformation of raw scores.

[1] = $P < .05$
[2] = $P < .01$

Since the lists did, in fact, differ in difficulty in spite of the pilot work done to equate them, it is not possible to say unequivocally that the sharp improvement shown by all groups but the older at the fast pace from the first to the second position was due solely to learning set formation.

The most unusual finding -- for which there is no ready explanation -- was that the best-performing group was the older group at the slower pace. As expected, however, the older group at the faster pace was worst, and the two younger groups did not differ substantially, although the younger at the faster pace did worse than those at the slower pace at all list positions but the sixth in total and omission errors. Surprisingly, also, the main effect due to age was not significant in any analysis. In accordance with prediction, however, the main effect due to pace was significant and in the expected direction for the total and omission errors.

It was hypothesized, you will recall, that if the faster pace affected the older subjects as predicted, then the deficit might in part be due to an age-related difficulty in concentrating upon the materials to be learned, and that giving subjects the opportunity to accustom themselves to the pace, the materials, and the presentation device -- in short, to form a learning set -- would ameliorate the difficulty. This appeared to be the case for the older subjects at the slower, but not the faster pace. It might be conjectured that the older subjects at the faster pace did, indeed, form a learning set -- but that they learned something other than what the experiment intended. That is, after a list or two they learned that the easiest way out of the situation was simply wait out the maximum nine trials, responding only to those items that came easily. A follow-up experiment might profitably be done comparing a condition in which all subjects proceed through a fixed number of trials with one in which subjects are instructed that they must reach criterion.

Present Status and Future

Much concerning the present status and the future plans of the project has already been stated or implied in the preceding material. This portion of the presentation will be devoted to summarizing plans and accomplishments, and to a brief review of some interesting side issues that have developed since the original proposal for the program of research was formulated.

As earlier noted, the research program has two major aspects. The first of these two involves the determination of adult age differences in (a) cognitive abilities (b) educational background, and (c) learning orientation. The present status and future plans for each of these will be treated briefly in order.

Cognitive Abilities

It was planned at the outset, as earlier noted, that exploration of adult intellectual functioning might profitably be accomplished with a number of tests utilizing a wide variety of different types of times. To this end we fashioned eleven vocabulary tests, each designed to tap knowledge in different areas of "everyday knowledge", and each containing items designed to appeal to different adult age levels.

The original eleven forms went through a preliminary analysis that resulted in the temporary shelving of five of the tests due to poor item characteristics. Those shelved for possible reconsideration dealt with arts, pastimes and hobbies, sports, fashions in attire, and current affairs.

The six tests retained for further immediate development were those titled finance, religion, transportation, death and disease, slang, and new words. These were revised to exclude "weak items", and administered to 151 adults recruited from community organizations and to 161 adults recruited from adult students enrolled in the graduate school of education. (These students were, for the most part, teachers in service working part-time toward permanent teaching certificates.) While the main purpose of this administration was the assessment of item characteristics without regard to age, some interesting data on adult age differences in performance were revealed.

The transportation test concerned knowledge of vocabulary related to various modes of transport, from horse-and-buggy to jet aircraft and rockets. The subjects were split at the median on age which turned out to be 30.5 years, and total scores for the two age groups were compared. A very small, but highly significant difference was found, favoring the older, over 30, group. It should be noted that the students -- presumably the better educated -- bulked disproportionately large in the under-30 group. Thus it appeared that experience, rather than formal education, was the more important factor in performance on this test.

Analysis of the slang test was handled differently. This test was constructed by sampling slang dictionaries, which gave an approximate date of first use of the words or phrases. The subjects were divided into three age groups, namely, under 30, 30 to 50, and above 50 years, and the percent of each group correctly answering each item on the test was calculated. The items were then segregated into two groups: Those correctly answered by increasing proportions of older subjects, and those increasingly difficult for older subjects. Happily for our hypothesis of the twelve items passed by increasing proportions of older subjects, ten were first used before 1950, the median date of entry being 1922. Of the ten items failed by increasing proportions of older subjects, only one entered usage prior to 1950. It should be emphasized that this was an informal analysis of data gathered for quite another purpose -- specifically, for the assessment of item quality independent of age of subject-- but the results were most heartening.

The original hypothesis guiding our construction of items for the "death and disease" test, was that familiarity with certain kinds of illnesses and with death would be greater among older than among younger adults. Again, as with the transportation test, subjects over 30 obtained a slightly higher but statistically significant mean score than did subjects 30 years old and younger. And, again, this was true despite the fact that the younger group had a disproportionately larger number of graduate students.

The finance test yielded results similar to those obtained for the transportation and life termination tests. The over-30's scored significantly higher in average total score a not unexpected result if one assumes that older individuals have had more experience in the management of money and property.

At this point, two of the six tests entering the analysis were temporarily shelved. The religion test was found to be too difficult for subjects, regardless of age. The items were highly illectual in nature, asking questions about Islam, Shintoism, etc., along with Judaism and Christianity. We intend to reconstitute the test, since there is evidence indicating age-related shifts in religiousness. The other test shelved was the "new words" test. We just disliked this test because of our inability to objectively characterize its content. It was constructed by sampling the Addenda to the Third New International Dictionary. A new test is being constructed from a list of words that appeared in the Third New International but did not appear in the 1909 edition. The list was constructed from a stratified random sample of the pages of the dictionaries.

Our plans for the future in this area include continued development of these special vocabulary tests, construction of additional tests of these and other types, and a continuation of our not previously mentioned development of a vocabulary aptitude test with two equivalent forms.

Educational Background

As earlier noted, our major instrument for the collection of data on the educational level of adults of various ages is the "Adult Basic Learning Examination," currently being developed for Harcourt, Brace, and World Publishing Company. (Not to be misleading---while Dr. Gardner is a co-author of this test, the research project discussed here is merely using this test, and is not in any way involved in its development other than in a sharing of data.) This test contains subscales relating to such knowledge and skill areas as arithmetic computation and problem solving, reading comprehension and memory for what has been read, spelling, and vocabulary. In late January we administered a form of the ABLE, several of our own tests, and obtained biographical data on 700 or so individuals of both sexes, ranging in age from the late fifties to the late eighties or early nineties. At the time this paper was

prepared, no analysis of the data had been done. Currently, arrangements are being made to collect similar data from union members and adult trainees in a technical institute, thus filling out our sample with adults of all ages from the twenties through the eighties.

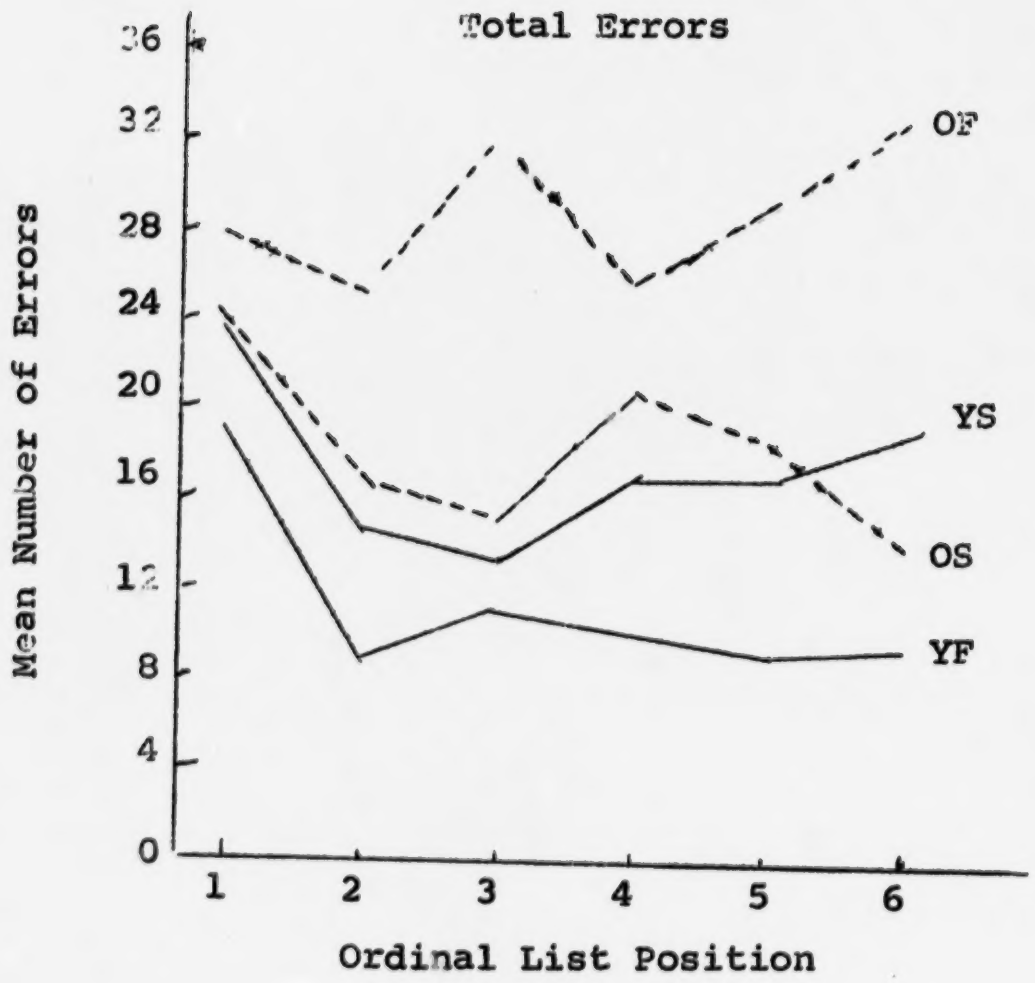
Learning Orientation

We plan to begin data collection in this area in the near future, using either existing instruments created by Ingham and Litchfield, earlier referenced, or modifications of these instruments. We are still reviewing literature in this area to determine just what approach we will take.

The second major aspect of the research project is the experimental investigation of the interaction of age with various personal characteristics in determining learning and performance. Two experiments, one on effects of the manipulation of social stress on performance of cognitive tasks, and one on learning sets and age, have already been described. Other experimental work will now be described briefly.

In a dissertation research project recently completed in our laboratory, Dr. David Hultsch[20], now of Pennsylvania State University, investigated the ability of males of different ages to organize material to be recalled. A 16-trial free recall task was given to men aged 16-19 years, 30-39 years, and 45-54 years. Subjects were required to write down after each trial as many of the 20 words presented as they could recall. Three instructional conditions were used: one in which Ss were just asked to recall as many words as possible; a second which suggested that recall would be easier if the words were organized in some unspecified way, and a third which told Ss to alphabetize the words as an aid to recall. He found that the older Ss recalled fewer words than the high school seniors, although no difference was noted between the two older groups. Furthermore, those of all ages with alphabetization instructions performed best, but the interaction of age and instructions did not appear. Thus, although the older men did not recall as much, what they did recall was as well-organized as the recall of the younger Ss. They were, in other words, as able as the younger to use either their own or an instruction-induced organizational scheme.

In a later reanalysis of the data, Hultsch[21] devided each of the three age groups into two sub-groups on the basis of their scores on a vocabulary test, and looked at the free-recall performance of the high vs. the low verbal facility individuals. In this reanalysis, he found no significant age differences among the high verbal facility group, nor were there differences due to instructional condition among this group. However, a significant age by instructions interaction was now detected in the low verbal facility groups. Under both the "standard instructions" and "organizational instructions" conditions, the high school boys recalled more words than the two older groups, which did not differ from each other;



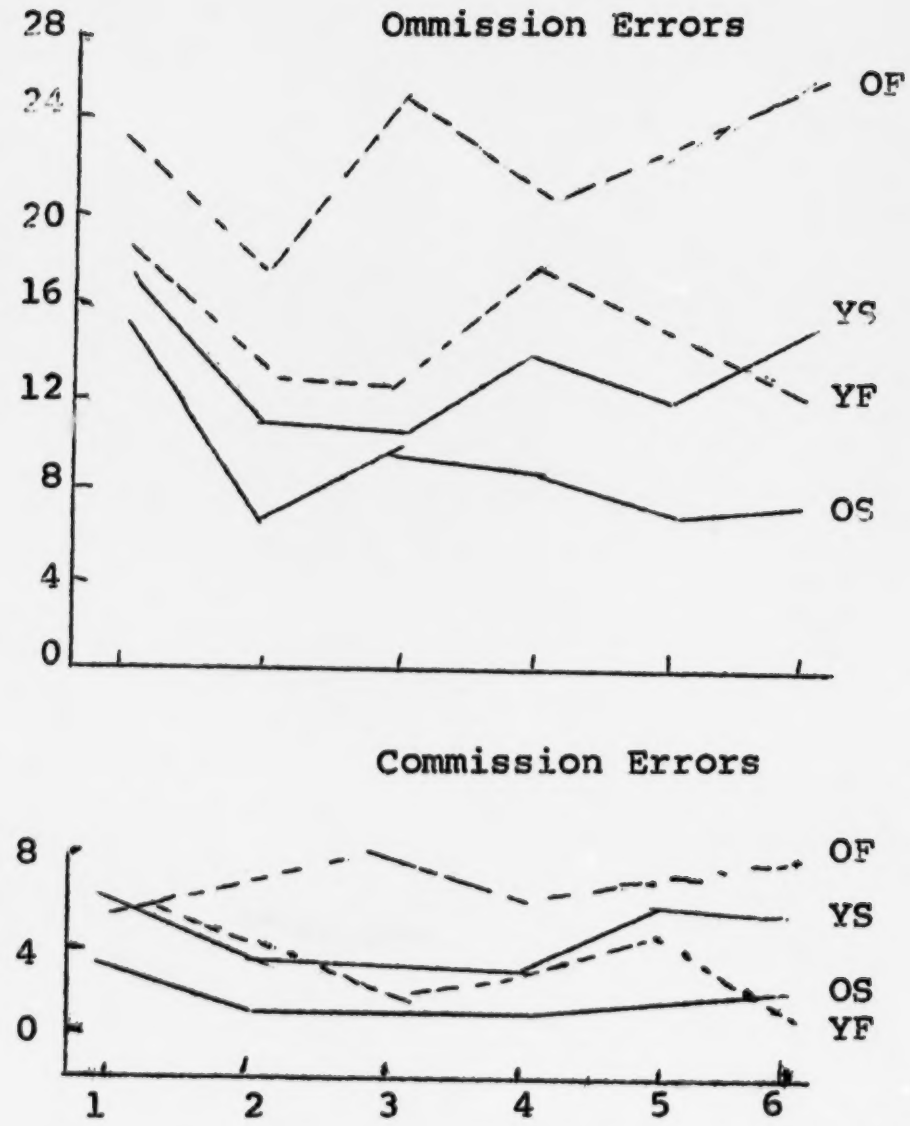


Fig. 1. Performance of Ss on six successively-learned lists of paired associates in terms of total, omission, and commission errors. The first letter of the label refers to age (O=Old, 60-69 years; Y=young, 30-39 years) and the second to presentation pace (S=slow, 4:2-sec; F=fast, 4:1-sec).

however, no age differences were dected among subjects performing under instructions to alphabetize their recall.

This presence of an age decrement in the case of low verbal Facility individuals, but not among high verbal facility people is quite interesting, particularly since it becomes apparent at such a comparatively early age, i.e., between, roughly, the late teens and the age of 40. Just why this is so is difficult to determine. It does appear, however, that at least part of the age-related decrement in recall performance was attributable to an age-related decrement in organizational processes. It appears that providing lower verbal facility people with a method of organizing material to be learned and recalled reduces age decrements in performance. Dr. Hultsch is presently following up on several suggestions produced by this research.

While we have no further data comparing different age groups, some of the pilot work we have done shows promise of further illuminating the interaction of age and performance. It is our practice to run pilot studies using as subjects adults enrolled in courses in the late afternoon and evening division of the graduate school of education. These are, of course, people of higher than average intelligence and educational attainment, and their ages form a highly-skewed distribution. The median age is roughly 25, the mean about 30, and the oldest ages represented rarely are greater than 50-55. Nevertheless, we can get some indications as to the usefulness of our experimental manipulations and measures, thus saving the harder-to-come by community-dwelling adults for refined investigations.

One such study tried to take advantage of the life-long habits of people to read from left to right, and to observe the results of reversing the process. In the pilot study, students of the type described above learned a list of paired associates in the usual fashion, stimulus presented on the left, and response term on the right. Another group of students learned the same list with the stimulus and response terms reversed in position, in other words, learned from right-to-left. A difference significant at the 5% level favoring the left-to-right group in mean number of trials to criterion was found. We are presently running this task using adults varying widely in age to test the hypothesis that older people will find it more difficult than younger adults to overcome the left-to-right habit.

We are also following up work earlier done on age differences in learning set development. One study currently in progress is examining the hypothesis that a subject's apprehension or anxiety about participating in a learning situation is, in part, a function of the difficulty of the task. Furthermore, it is hypothesized that the older the adult, the greater will be the disturbance produced by a difficult as compared with an easy task. Thus, learning set development will be slower if it is accomplished by exposure to

more difficult materials, and especially slower in older adults. Our experimental approach is to expose half of an age-group to four difficult lists of paired-associates, followed by four easy lists. The other half of each age group will learn the four easy lists first, and then the four difficult lists. Our specific predictions are that (a) the learning rate of the older subjects will more closely approximate the rate of the younger subjects on lists later in each series than on lists earlier in that series, (b) that the improvement in learning rate over each of the series will be greater for the old than for the young, and (c) that these differences will be accentuated in the instance of difficult over easy material. Two of these comparisons ("a" and "b") represent, of course, two ways of assesing the same outcomes.

In the experimental area, our major future goals are related to the three main hypotheses earlier articulated. We plan to investigate the effects of various klnds of stress, of favorable, unfavorable, and neutral attitudes, and of previous experience (learning sets) on the learning and performance of adults of different ages, of both sexes, and of various socio-economic backgrounds.

Thus far, the experimental work has not been concerned with verbal materials of a very high degree of complexity. Future work will be little concerned, except incidentally, with standard laboratory apparatuses and verbal materials such as memory drums and paired words. We have constructed sentences, short paragraphs, and longer passages of verbal material to use in learning and performance tasks. We plan, in short, to move closer and closer to the kinds of learning tasks faced in real life by real adult learners, while at the same time exercising control over the experimental and personal variables indicated by our hypotheses. If we do a good job, we'll end up with more unanswered questions than we started with, but also with more answers.

Closing Remarks

As the formal title of the project states, the aim is to provide "backgrounds for adult education and vocational retraining". We do, however, feel responsible to professionals in applied fields for more than just conducting the research and publishing the findings. First, we feel responsible for intepreting our results in broader social and psychological terms than is customary in scientific publications, so that we both reach a wider audinece and make the work more meaningful to it. Second, realizing that our focus and experience tend to limit the kinds of questions we ask, we feel a responsibility for establishing and maintaining lines of communication with the people who work closer to "where it's happening", so that we may expand our horizons. And finally, we seek critical comment upon the utility of our findings and interpretations, so that we may correct errors of interpretation and fact. We hope that contributing to this workshop will, at the very least, alert you to be on the lookout for further developments from our work, but more

than that, will engage all of us in exchanging ideas and constructive criticism on a continuous basis.

Our findings will, we think, help to dispel the feeling of hopelessness exemplified in the saying, "You can't teach an old dog new tricks." There is evidence to suggest that this is an attitude held both by those engaged in working with older adults, and by the older adults themselves. There are, unquestionably, losses with age in factors associated with performance, i.e., in acting or reacting in situations requiring the overt display of acquired knowledge. There is, however, no good evidence at this time to indicate that the fundamental ability to learn decreases until very, very late in life. There is certainly no evidence for decline in this basic ability during the normal working years, say up to an including the middle and late sixties for most people.

It must be realized that an individual's expectations are powerful determiners of both his behavior and the behavior of those he influences. This has been graphically demonstrated by Professor Robert Rosenthal[22] pf Harvard University in his work with elementary school teachers and their students, even with research psychologists expecting certain kinds of performances from animals. In one experiment, Dr. Rosenthal divided a group of elementary school pupils into two subgroups. The pupils in one group were identified to their teachers as children who were about to bloom intellectually. The other subgroup was equally qualified, but was not specially identified to the teachers. At the end of a few months, he found that the "bloomers" had, indeed, showed increases in achievement significantly greater than the "control subgroup". The preferred explanation for this finding was that the teachers expected the specially-marked children to bloom, and that -- through their interactions with these children -- they had subtly, and perhaps not-so-subtly, communicated their expectations to the children and had provided an environment that had stimulated and supported the children's efforts.

There is good reason to believe that the "Rosenthal effect" would appear in many interactions between individuals; in fact, it is safer to assume that it will occur than that it will not. The message for us here is that expectancies should, at the very least, be realistically based and, in appropriate circumstances, biased to favor a desirable outcome. It is the scientist's business to determine the shape of reality, but the educator's business is reshaping reality. Thus, the scientist's expectancies must be neutral, but the educator is free, within the limits of good conscience and good sense, to mold expectancies in order to further educational and personal development. It should not be necessary to point to the potential for mischief and misfortune inherent in unethical or ignorant manipulation of expectancies. Everything in moderation!

Thus, to summarize, what one expects of the "old dog" confronted with a "new trick" may be as important as the technique one uses for teaching him the trick. It is our expectation that what we learn about the capabilities and limitations of adults of various ages will permit you to base -- and bias -- your expectancies to best serve your students.

Footnotes

1. Prepared for the University of Chicago Workshop to Increase and Improve University Teacher Training Programs in Adult Basic Education, March, 1969.

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